Urban Transport Options in China: The Challenge to Choose

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Summary of a Forthcoming Book

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China's Energy Consumption and Opportunities for U.S.-China Cooperation to Address the Effects of China's Energy Use
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Project Background and Objective

EMBARQ, the World Resources Institute (WRI) Center for Sustainable Transport, has commissioned a series of papers on the energy and environmental impacts of transport policy options in China. The objective of these papers is to provide guidance to decision makers – governments, multilateral development banks, donor agencies, and the private sector – on the development of sustainable urban transport policies in China. In addition to sustainable urban transport, these papers also address land use and access, transport's environmental impacts, fuel use and technology, and pricing options for transport and fuel policies. In order to present a realistic view of transport challenges and solutions, each chapter is produced by a team of both Chinese and international authors. These papers attempt to integrate the concept of sustainable urban transport into Chinese policies, and also to identify the transport challenges specific to China, the policy options available, the current state of such policies, and priority areas for Chinese policymakers. A second goal is to establish trust and partnerships between Chinese and other international experts, so as to create future opportunities for collaboration. The full text will be published in 2007 in Chinese. This document summarizes the full report written for Chinese decision makers.

Sustainable Transport for China

Sustainable transport can be defined in social, economic, and environmental terms. Governance is also critical because it establishes and enforces rules, creates procedures for monitoring and evaluation, and supports stakeholder dialogue to make the process of policymaking as open and transparent as possible. In this framework, China's urban transport does not appear to be developing in a sustainable manner. Congestion, traffic accidents and fatalities, and urban air pollution from the transport sector have all been increasing over the past two decades. The number of accidents and amount of emissions of many pollutants per kilometer are falling, but the total distance traveled by motor vehicles is increasing rapidly, resulting in greater absolute numbers of accidents and more pollution. The rise of individual motorized vehicles implies that

[1] EMBARQ's global strategic partners around the world are the Shell Foundation and the Caterpillar Foundation.

more and more pedestrians and cyclists are crowded off city streets. An example can be seen in Shanghai, where some roadways in major cities have banned the use of bicycles (Figure 1).

Figure 1. No bicycles sign in Shanghai. Photo taken by L. Schipper (2001).

Several of our authors make it clear that the foundation on which China's urban system was built - non-motorized transport in combination with buses and various rail systems - is increasingly unstable. The huge increase in urbanization and urban migration overwhelms the bus and rail systems at peak hours and encourages the use of private motor vehicles. What makes urban transport - transport of people and goods in, around, and through cities - in China particularly vulnerable is a high density of population. This means both a larger likelihood of collisions between people and vehicles, and a higher density of emissions from vehicles than in a rural setting. In addition, with so many more people in an urban region, the overall impact of exposure to air pollution and congestion is higher simply because more people are affected by these problems.

We have limited the scope of these papers to the urban passenger transport sector, though we recognize that this excludes all important freight delivery sectors within cities. We have also excluded intercity traffic, which in China is principally trucking and inland waterways (for freight), air, bus and rail (for passengers). This omission excludes a significant portion of China's road fuel consumption and carbon dioxide (CO_2) emissions, as well as local emissions from heavy vehicles on intercity roads. On the other hand, the pollution damage and congestion from high density cities is probably much greater than it is in rural areas. Traffic fatalities are another concern, since inter-city traffic tends to be at higher speeds and often passes on trunk roads through previously settled areas. Our assumption is that this urban-centered traffic could contribute to approximately 20 percent of traffic fatalities, most of the congestion and air pollution damage, and approximately 30 percent of the fuel use and CO_2 emissions in the transport sector as a whole. These shares are rising rapidly because of the rise of private motorization, traffic and population in urban areas. Not surprisingly, energy security is becoming a growing concern for those worried about the vulnerability of China's transport sector to fuel supply problems, at least in part because of record high prices (though the price of crude oil had decreased somewhat from its 2006 peak by spring 2007) and the increase in annual oil imports.

The issues related to sustainable transport confronting China and many other developing countries are different from those that developed countries face today. Growth in motorized transport in developed countries was spread over more than 50 years since World Word Two, with slow development of infrastructure. Germany and Japan re-developed after World War Two, building on lessons learned during decades of infrastructure growth. For China, however, most of the infrastructure and almost all of the vehicles that could be seen on the streets by 2020 are not yet in place or manufactured. Rapid urbanization also means as many as 600 million Chinese may live in cities by 2030, a number that will constrain population and space. Most of the infrastructure required has not been built, so China has flexibility similar to what Germany and Japan had in the late 1940s to choose how to develop urban areas.

Rapid economic growth in urban cities implies there will be an increasing number of households who can afford private passenger vehicles. Thus, China is confronted by the enormous demands of urban infrastructure, to create urban space and capacity. However, Chinese authorities can ensure that such infrastructure is provided in the most sustainable manner, both through regulations and through market mechanisms. Doing so will allow Chinese authorities to choose the shape of their transport systems for much of the 2030 picture. These papers discuss some key options China might choose.

Motorization in China

A message repeated by all the Chinese authors in this report is that rising congestion, fatalities, more motor-vehicle-based air pollution, and greenhouse gas (GHG) emissions from the transport sector demonstrate China's movement away from sustainable transport solutions. Motorized passenger transport contributes heavily to these indicators. Even though the share of individual private transport – automobiles and two-wheelers – is relatively lower in China today compared to many other developed countries, these modes are growing so rapidly that by 2020 they could provide as much as 20 percent of all trips and 30-40 percent of all distances traveled. This rate of growth of distance traveled is rapid enough to lead to increases in absolute numbers for accidents, fatalities and pollution, even if accident and emission rates per kilometer fall. In addition, this rapid growth in traffic has already far outpaced any authority's ability to provide road space, parking, and car storage, or effective policies, regulations, and enforcement.

Figure 2 shows how automobile ownership in China, Korea, Japan, the United States (US) and Germany grew as each country's per capita GDP grew. Time generally moves to the right as per capita GDP grows, but a recession (such as happened after the 1929 stock market crash) can cause the points to loop back on themselves, which explains the strange behavior in the US line. The earliest points for the US are from the early 1900s, when cars were still a novelty. Note the logarithmic scale: China's per capita GDP increased by the same factor between 1987 and 2003 as did that of the US in a period more than three times longer.

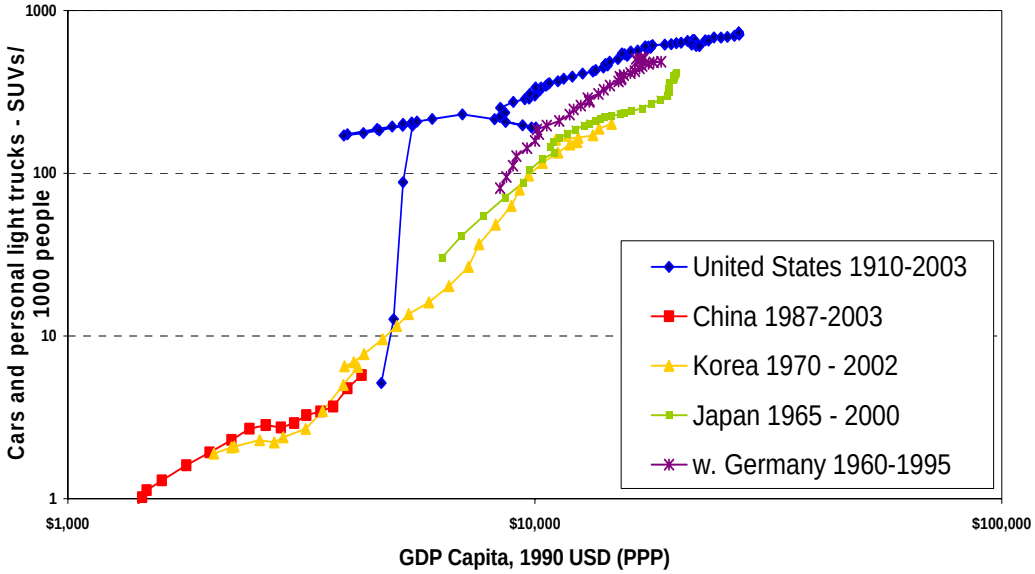

Figure 2. Growth trends of global vehicle ownership.

As shown in Figure 2, China's growth is not as rapid as was early growth in the US. However, because cars cost relatively less today and are of higher quality than they were in the 1910s, China has managed to reach a comparable level of car ownership at lower GDP per capita than did the US. Automobile production is taking off rapidly in China just as production of electronic appliances has taken off there two decades earlier. Is there anything to hinder the same development of car production and ownership as for appliances in China? Indeed, note the way in which the path for China today resembles that of the early years of development of Japan or Korea. While this strong resemblance is no guarantee that China will continue to move along the same path, it should be a signal to authorities that such a path to motorization is possible. This volume considers some options to both mitigate the consequences of rapid motorization and to reduce the need for such rapid growth in automobile use.

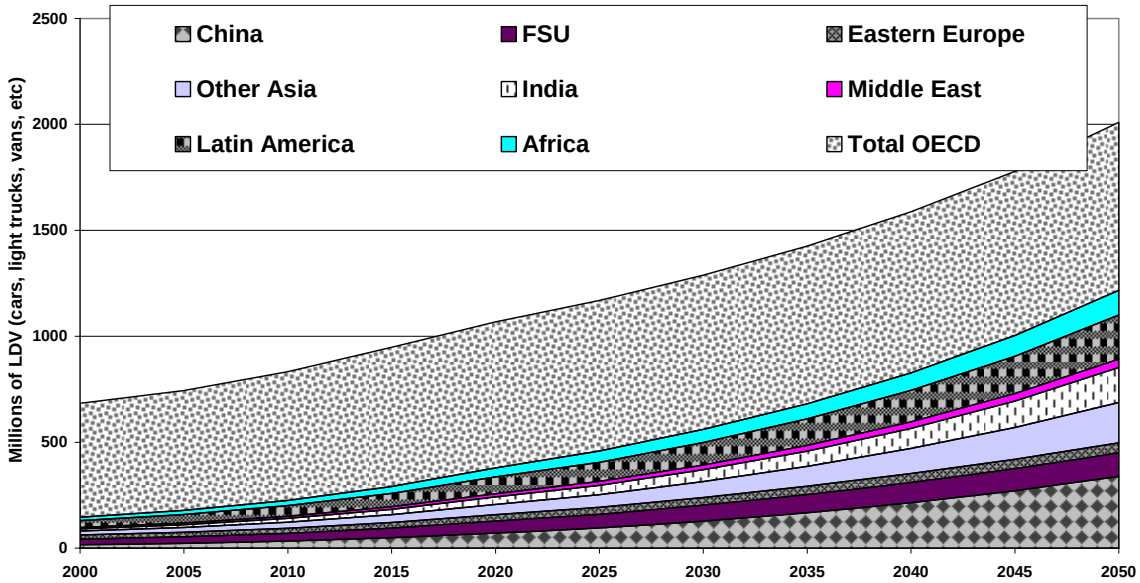

Figure 3. Projected light duty vehicle ownership by region, 2000-2050.
Source: WBCSD-SMP (2004).

Figure 3, from the World Business Council for Sustainable Development "Sustainable Mobility Project" forecasts light duty vehicle (cars, vans, SUVs) ownership around the world from 2000 to 2050. China's share is predicted to rise from insignificant to well over 15 percent of the global total, and its vehicle production is also expected to increase rapidly. One of the factors leading to this growth trend is urbanization. There were 139 Chinese cities of over 750,000 residents in 2005, compared to just 9 in the United States (Table 1). Chinese cities are growing at a rate of 10 percent annually; from 1978 to 2004, the urbanization rate increased from 18 percent to 42 percent, leading to an urban population of 540 million (Zhou and Lin, 2005).

Number of Cities Over 3/4 Million Population		
China	India	United States
139	57	13

Table 1. Number of Cities with Over 750,000 Inhabitants
Source: United Nations, Department of Economic and Social Affairs, Population Division (2006).

It is important to note that the definition of a "car" in official Chinese statistics is sometimes misleading, as it could mean "motor vehicles" in the English context. According to the Chinese national standard,[2] the definition of a "car" includes motor vehicles used for passenger, freight and commercial purposes, such as taxis, buses, vans, minibuses, trucks, as well as automobiles. Cars, i.e. automobiles, will usually be under the category of "passenger cars," which also refers to any vehicles with seating capacity of less than nine, including ambulances. In the past it was unclear if data for the different classifications of motor vehicles were available, or if car ownership referred to the ownership of the same motor vehicle in both the English and Chinese

[2] *Motor Vehicles and Trailer – Types – Terms and Definitions*, 2001. The People's Republic of China National Standards, GB/T 3730.1 – 2001, the General Administration of Quality Supervision, Inspection and Quarantine of the People's Republic of China.

context. Therefore, the number of cars or automobiles in China could have been lower than reported. Nevertheless, the total number of motor vehicles still shows a rapidly growing trend, and more recent data clearly show the rise in automobiles as known in the west.

China in a Global Context: Fuel and CO_2 Emissions for Motor Vehicles

As oil prices approached record levels in 2005, many analysts erroneously blamed rising oil demand in China, supposedly being propelled by an increase in Chinese automobiles. In fact, demand for gasoline for China's passenger automobiles and vans (up to 9 seats) lay around 350,000 barrels per day in 2003, and we estimate it at closer to 450,000 bpd in 2006. That of the US was close to 7 million barrels per day in 2006. Indeed, the approximately 1.5 percent annual increase in US gasoline use for cars, equal to around 150,000 - 200,000 barrels of oil per day, is nearly equivalent to half of China's total consumption of fuel for cars in 2003. Indeed, China's total oil consumption (Figure 4) is smaller than the US consumption of gasoline for light duty vehicles alone. What is important is that today's fuel use for automobiles, while growing rapidly in China, is still tiny on a global scale, and is even small as a share of total oil consumption within China (Figure 5). Yet, as most authors in this volume note, growth threatens China's economic stability, because it depends on imported oil, and China's growth in oil demand is an important part of overall global growth in oil demand (Figure 6)..

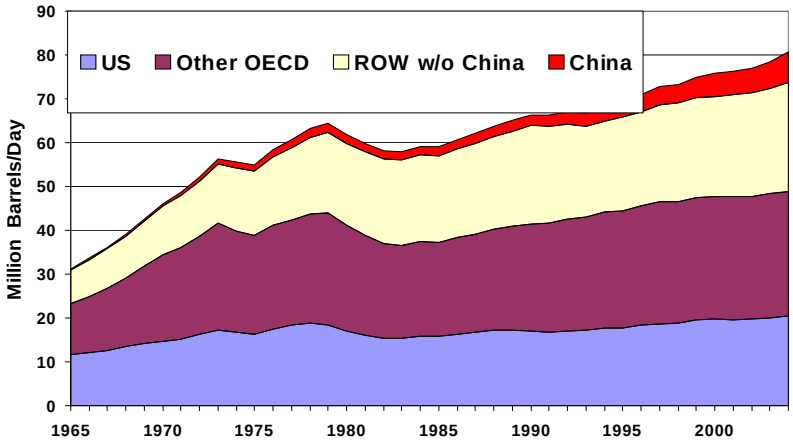

Figure 4. World oil consumption from 1965 to 2004.
Source: BP (2005). (ROW is "rest of world")

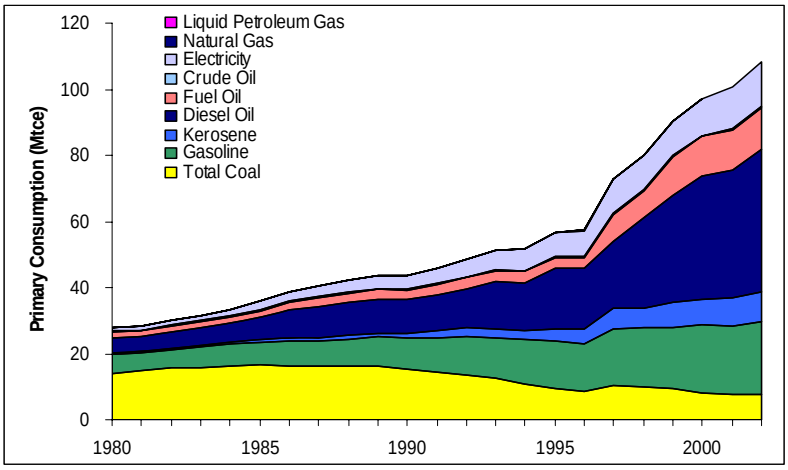

Figure 5. Shares of final energy consumption in transportation in China.
Source: D. Fridley, Lawrence Berkeley Laboratory (2004). Private Communication.

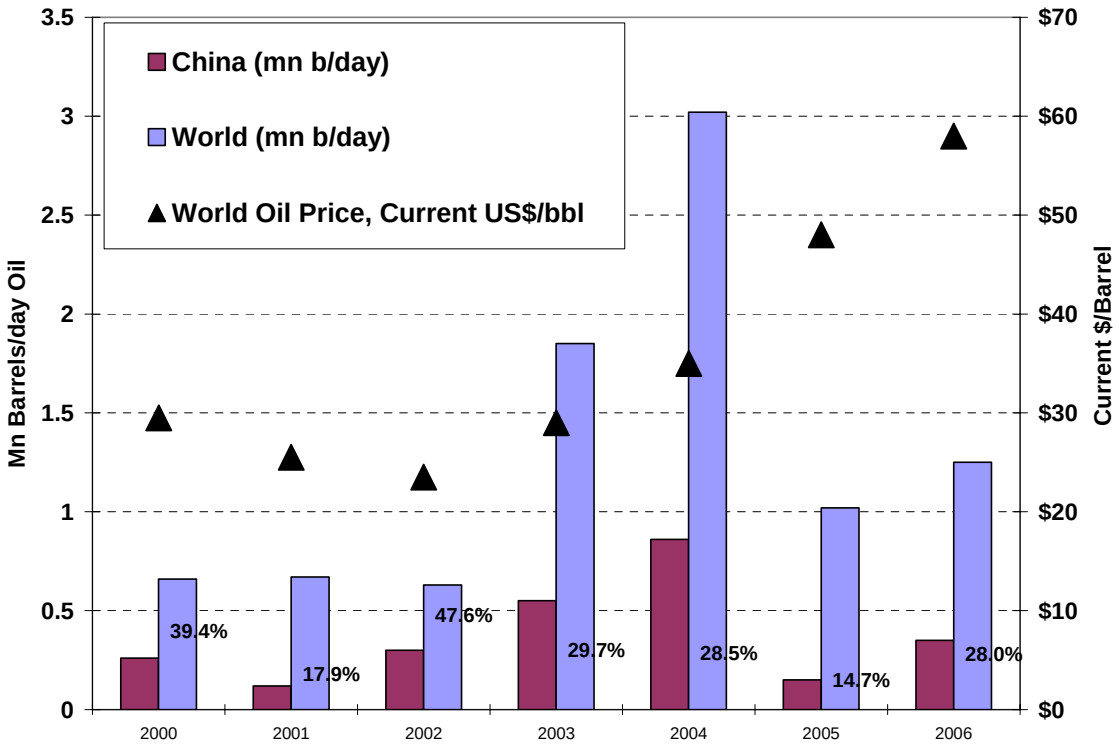

Figure 6: Annual Growth in World Oil Demand with the demand of China (and its share). World Oil Prices also shown.

The present impact of China's car use and the road transport sector as a whole is small, as evidenced by the origin of CO_2 emissions. Figure 7 shows CO_2 emissions from all fuel use in 2003, relative to GDP (converted to year 2000 USD at purchasing power parity). Although China's CO_2 to GDP ratio has been falling by more than 4 percent per year since 1990, it is still higher than the other countries shown in Figure 7, reflecting many inefficiencies in China's energy use. What is significant, however, is the small share of road transport in that ratio,

comparable only to that of India's. Indeed, given that the US population is less than a quarter of China's, this means that Americans used 60 times more fuel, per capita, than did the Chinese. Even relative to GDP, the US is by far the dominant force in the world gasoline market. The challenge for China is to tame its urban transportation problems in a way that regulates road transport, along with all the negative consequences it might otherwise bring.

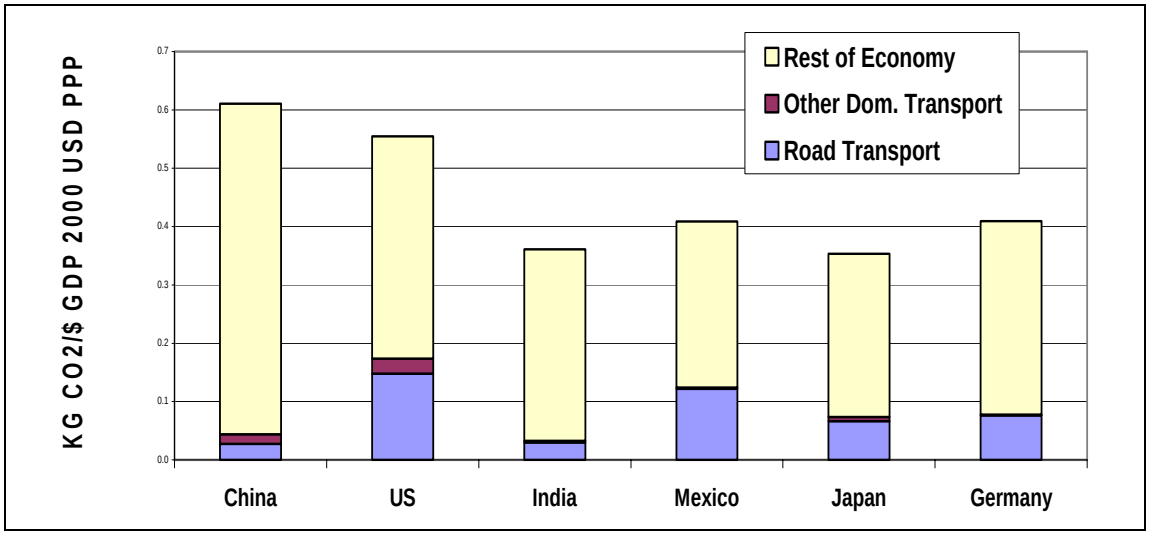

Figure 7. CO_2 emissions per GDP, converted to 2000 USD Purchasing Power Parity (PPP), in China and five other countries in the year 2003. "Other domestic transport" reflects air, rail, and water-borne transport. Source: International Energy Agency.

Chapter Summaries

In this report, we have selected a diverse group of authors to provide solutions to the urban transport problems China currently faces. *EMBARQ* has asked Zhou Wei, Wu Hongyang (both from the Chinese Academy of Transportation Sciences) and Edward Dotson (the World Bank) to describe the imperative of sustainable transport as it applies to China (Chapter 1). Lu Ximing, Gu Yu (both from the Shanghai City Comprehensive Transportation Planning Institute), Ralph Gakenheimer (Massachusetts Institute of Technology) and Jiawen Yang (Georgia Institute of Technology) tackle land use as a major force behind rising mobility and motorization in China (Chapter 2). Eduardo Vasconcellos (Movimento Engenharia, Brazil), an internationally recognized authority on collective transport, and his co-authors Quan Yongshen, Liu Ying and Chen Jinchuan (all three from the Beijing Transportation Research Center) discuss China's transport modal choice options in the context of a rapidly growing urban sector (Chapter 3). Michael Walsh (Consultant) and Michael Wang (Argonne National Laboratory) examine how to reduce the growing air pollution problems from motor vehicles in China's cities (Chapter 4). Ni Weidou (Tsinghua University), Bai Quan (Beijing Energy Efficiency Center) and Dan Sperling (University of California, Davis) address the prospects for alternatives to petroleum-based fuels for China's transport sector, which affects oil security, as well as local air pollution and greenhouse gas emissions (Chapter 5). Feng An (consultant) and Lew Fulton (United Nations Environment Programme) present the case for more efficient motor vehicles, principally cars, as the balance between supply and demand (Chapter 6). Professors James Sweeney (Stanford

University) and Wang Yi (Chinese Academy of Sciences) show how fiscal policies and pricing instruments can be used to tie together many technical and regulatory options (Chapter 7).

Summary of Chapter 1
Understanding Sustainable Transportation and its Implications for China
Zhou Wei, Wu Hongyang, and Edward Dotson

Sustainable transport is defined as the establishment of a transport system that meets the transport demands of the public without compromising the environment. Environment in this chapter includes biophysical, ecological, and socio-cultural aspects of development, as well as the physical environment. Even without accurate indicators to gauge China's transport system against these criteria, it is clear to any observer that there are several sustainable urban transport challenges in China that must be addressed. The lack of well-structured and organized national or local institutions solely responsible for urban transport, as well as low technical and institutional capacities, contribute significantly to the current state of poor transport sustainability in China. In addition, increasing pressure from rapid urbanization and motorization has created urgency to develop and enforce sustainable urban transport policies.

Figure 8. Different transport modes sharing same road space. Photo taken by L. Schipper (2004).

Summary of Chapter 2
Land Use and Transport Access
Ralph Gakenheimer, Jiawen Yang, Ximing Lu, and Gu Yu

Chinese cities, and physical access within them, are in a rapid transition as a result of increased wealth and changes in social structure and governance. China's urban population grew by 180 percent from 1982 to 1999. This growth, along with land and housing reforms and economic development, caused changes in urban land uses and densities. Land use and transport demand changes in China can be seen most prominently in Shanghai. Over the past 30 years, Shanghai has gone through three very different types of urban and transport development, where different urban patterns have resulted in different transport networks and modal split. Two of the major changes are the growth in motorized vehicle ownership and the number of daily public transport passengers, both of which suggest increases in travel demand and travel distance. Policy options for sustainable transport land use patterns, which require the commitment of local governments to

recognize the connection between transport and land development, are discussed. National policies are also essential in determining the objectives of land use planning.

Figure 9. Shanghai Bund. Photo taken by L. Schipper (2004).

Summary of Chapter 3
Modal Choices
Eduardo A Vasconcellos, Quan Yongshen, Liu Ying, and Chen Jinchuan

The decision of an individual to walk, cycle, take public transit, or drive a private car depends on urban development, as well as social, cultural and economic constraints. Income, age, gender, and cultural or religious beliefs are important factors, as is the availability of the chosen transport mode. Different transport modal choices present varying degrees of impacts on accessibility, financial costs, natural resources consumption, traffic accidents, pollution, and congestion, with the speed of modes playing an important role in what the traveler chooses. Among motorized means of transport, railroad transport and buses consume the least energy, while private vehicles consume more energy per passenger-km. Therefore, the higher the share of private vehicles, the more energy that will be used. Experiences from Singapore and Curitiba, Brazil demonstrate successful changes in urban mobility trends and modal shifts as a result of different transport strategies and policies intended to ensure development of energy- and cost-efficient public transport and non-motorized transport.

Figure 10. Different transport mode users at busy junction in Shanghai . Photo by L. Schipper (2001).

Summary of Chapter 4
Fuel Economy and Technology
Feng An and Lew Fulton

China's total oil demand is projected to reach 14.2 million bbl/d by 2025 (with a net import of 10.9 million bbl/d) and will be an increasingly key factor in the global oil market. The rapid growth of motor vehicles has been a significant cause of the increase in oil consumption in China. As a measure to regulate energy consumption and reduce air pollution from transport, China announced its first fuel economy standards in October 2004. More fuel-efficient vehicles are expected to be produced following the implementation of the standards, as has occurred in other countries. Japan and Western Europe achieved significantly higher new light-duty vehicle fuel economy from 1995 onwards, when strong reductions in fuel use per km and implementation of strong fuel economy measures occurred. Chinese fuel economy standards must be complemented with other policies in order to regulate vehicle fuel consumption. Other complementary policies include taxes on vehicle manufacturing and sales, fuel taxes, in-use vehicle taxes, and the development of advanced fuel-efficient vehicle technologies, such as hybrid electric vehicles, diesel vehicles, mini cars, and electric-drive vehicles.

Figure 11. GM Buick in Shanghai. Photo taken by L. Schipper (2004).

Summary of Chapter 5
Alternative Fuels in China
Ni Weidou, Bai Quan, and Dan Sperling

The challenge of fueling China's transport system became apparent when China became a net oil importer in 1993. Future challenges are daunting as both the environmental and fiscal impacts of producing energy and usable fuels raise increasing concerns for Chinese authorities. Some alternatives to petroleum have proven successful in reducing the intensity of pollution and exhaust emissions when used in motor vehicles. Fuels that could substitute for conventional petroleum fuels in internal combustion engines include methanol, ethanol, liquefied petroleum gas, natural gas, electricity, hydrogen, and fuels derived from coal. While almost all of these substitutes cost more than petroleum fuels, China's increasing dependency on imported oil, rapid development of motor vehicles, and high levels of urban air pollution mean that alternative fuels could effectively and efficiently reduce the negative impacts of motorization. Since China is only at the beginning of its motorization, its investment to-date in fueling infrastructure is relatively

small. China still has an opportunity to save money in the long term by beginning to invest in alternative fuels now. Measures to further advance alternative fuel vehicles are significant to China's sustainable transport development. Recommendations in this chapter include: strengthening the leadership of the state; formulating reasonable and active plans for alternative fuels promotion; conducting life-cycle analysis; increasing investments and evaluating externalities; conducting thorough research and organizing large-scale tests on the sustainability of alternative fuels in China; and establishing and implementing national standards for potential substitutes for conventional fuels and engines. The right approach is to develop and deploy the right fuels and vehicles in the right place at the right time.

Figure 12. Fuel cell car from Tsunghua U., Beijing. Photo taken by L. Schipper (2006).

Summary of Chapter 6
Fuels, Vehicle Emission Controls, and Air Pollution
Michael P. Walsh and Michael Wang

According to the World Health Organization (2005), only 31 percent of 388 monitored cities in China met their country's standard for air quality in 2005. In fact, some large Chinese cities have been ranked as the most seriously polluted in the world. With the rapid growth of motorization and the use of private motor vehicles, vehicle emissions are becoming a greater source of urban pollution. The combustion of gasoline or diesel fuel in vehicle engines produces a variety of potentially harmful emissions. The amount and type these emissions depends on a number of factors, including engine design, operating conditions, and fuel characteristics. Gaseous and particulate pollutants contributed by motor vehicles include carbon monoxide, nitrogen oxides, ozone, toxic hydrocarbons, particulates, and greenhouse gases. Because a large number of people are exposed to vehicle emissions, the effects on overall public health are of great concern. China has already adopted strong motor vehicle pollution control measures to reduce vehicle emissions by eliminating the use of leaded gasoline and introducing the EURO emission standards. However, the reduction of sulfur content in vehicle fuels, inspection and maintenance programs, reduction of emissions from in-use vehicles, and in-use compliance programs all need to be improved.

Figure 13. Vehicles with high emissions level still used in Xi'an. Photo taken by L. Schipper (2004).

Summary of Chapter 7
Economic Instruments in Transport Polices
Wang Yi and James Sweeney

The negative impacts of transportation, such as highway congestion, local air quality, carbon dioxide emissions, and highway fatalities and injuries, each include a significant externality associated either with the amount people drive or the characteristics of the vehicles they drive. Users of China's transport system today do not pay the costs of externalities when they travel, and may not even cover the basic costs of the road infrastructure through fuel taxes and other fees related to vehicle use. Although the various classes of externalities correspond to the underlying problems to be addressed, market interventions typically cannot directly be applied to any of the variables of concern. Rather, interventions can be designed to affect factors directly under control of the individual or under control of the firms selling into the market. Market interventions can thereby have indirect impacts on the various classes of externalities. For example, increasing fuel taxes will increase the cost of driving, which can discourage unnecessary trips, and so reduce distance traveled and vehicle emissions. Important factors to consider include vehicle kilometers, emissions, fuel efficiency, fuels, and driving behavior. Understanding these factors will allow the prioritization of pricing policies. Although there are several transport-related fees and taxes in China, they do not effectively reduce different transport externalities, as most fees and taxes do not affect the use of motor vehicles. Recommended policies include improving parking pricing systems, establishing transit-oriented development, and financing public transport systems.

Figure 14. Modern flyover in Shanghai**.** Photo taken by L. Schipper (2004).

Summary of Conclusion
Lee Schipper and Wei-Shiuen Ng

As most of the chapters show, all the impacts of motorization are growing rapidly in China. They require urgent solutions from different areas that will ultimately affect the development of sustainable transport. Without action, China will not be able to channel its peoples' understandable desire for mobility into a sustainable transport system, particularly in urban areas.

Among the actions reviewed and proposed in the chapters in this volume are:

- Establishing of cross-cutting authority at the local and national level to both analyze current and future problems (including collecting data), and to develop hard-hitting policies to foster change towards more sustainable transport;
- Strengthening the link between collective transport systems and land use to encourage use of public transport before cities sprawl hopelessly beyond the reach of all but individual motorized transport;
- Strengthening the role of non-motorized transport (walking, cycling) through both better physical protection of walkers/cyclists and better integration of these modes with motorized modes;
- Considering different forms of ownership, financing, operation, and regulation of public transport;
- Recognizing the importance of vehicle and fuel taxation, fuel economy standards, and restraint in the growth of the size and power of cars as parts of the drive to limit fuel consumption;
- Recognizing the importance of restraint in fuel demand in order to allow orderly development of alternatives to petroleum, with use of market signals (such as fuel prices) to help signal to vehicle users and vehicle manufacturers the "best" fuels;
- Strengthening the standards for new vehicles and fuels, as well as monitoring both emissions from vehicles in-use and urban air quality itself, in order to mitigate transport's rising role in contributing to air pollution;
- Recognizing the importance of markets for both price signals on vehicles, fuels, and road use (i.e., congestion pricing) and for developing the best ways of creating, financing and operating urban transport systems.

The role of the Government of China is especially crucial in pursuing advanced transport technologies, improving performance standards, alleviating negative environment and health impacts, and introducing appropriate fiscal instruments that will influence vehicle choice and use. While efficient vehicles and alternative fuels are necessary for restraining the rise in energy use, these elements alone are not sufficient for holding back the rapid growth in oil demand. Integrated urban transport solutions with a mixed transport modal share are also needed to keep China's cities livable and vibrant. Future projects should focus on establishing good data collection and management tools, as well as exploring measures to integrate transport needs with urban land use, and understanding the direct impact of urban land development on transport demand. Another crucial area for future projects is the role of transport pricing policies.

Figure 15. BRT bus corridor in Beijing. Photo by Manfred Breithaupt, GTZ Photo Survey (2006).

The State of Urgency

A common theme among all the Chinese authors in this book is the urgency of action. That urgency is understandable. China's motorization is very rapid for a country so early in its development and urbanization. In these ways, China is "behind" its own development in terms of physical infrastructure. Examples described in the report include:

- The demand of car ownership and use is rapidly overtaking the supply of roads and other transport infrastructure. Indicators from almost every Chinese city show less space per car every year. Authorities increasingly recognize that simply building roads or flyovers will not solve congestion problems.
- Many of the institutional arrangements that underpin urban transport are in need of reform as markets open and streets become crowded.
- Institutional and intellectual capacities required to manage rapid urbanization and private motorization are not in place, partly because the takeoff was barely more than a decade ago. With the rapid speed of motorization in China, decisions affecting literally tens of billions of dollars of public and private investment must be made without much experience in using tools for cost and alternative analyses.
- The relative novelty of rapid urbanization and motorization limits the experience that authorities and private and state companies have using tools to diagnose problems, compare potential solutions, evaluate results, correct unanticipated side effects or strengthen results, and finally to communicate results.

There are other stories, particularly the mounting tales of ordinary people stuck in traffic, and families separated as households are relocated to make room for further development. Yet these stories reflect an opportunity for China to point its relatively young motorized transport system in a new direction.

China's Opportunity – Choice Now, Not Costly Change Later

The impact of rapid motorization in China is the overriding theme of this volume. The low motorization rate in China means that China has many opportunities to avoid the problems we describe in this book. It is easier and more cost-efficient for China to consciously choose a sustainable transport path now than to wait to change that development path later.

Consider first the low ownership of personal vehicles. As two- or four-wheeled vehicle ownership is still low, vehicle ownership and habits are malleable. In developed countries, the use of individual private motor vehicles was developed gradually over a century. Individual travel patterns are almost fixed as 90 percent of trips in American cities and approximately 70 percent in European cities are made by cars. However, in Chinese cities, less than 10 percent of trips are made by cars and taxis. Therefore, China does not need to reverse any travel patterns to be sustainable. Rather it must develop alternatives that will soften the negative impact of individual motorization, regulate the rate of growth, and strengthen available transport policy options.

A majority of Chinese continue to use sustainable transport modes, such as walking, cycling and taking public buses. However, these are threatened by changes, some of which are unavoidable as incomes rise and urban settings evolve. Other changes are brought on by policies, some of which reinforce the urge to move to private individual transport for the bulk of trips, i.e., the American mode or the South East Asian mode based on two wheelers.

Land use patterns in China present a particular challenge. They are not yet fully determined by years of automobile-driven evolution or rail-driven sprawl. Instead, just two generations ago, cities were small and compact, with most transport by foot and cycle. Most important, population densities are high, and have grown in the economic booms seen in Shanghai and other leading cities. Here again China can choose to either proceed into low-density development fed by automobiles and a few rail or bus lines, or to control sprawl by centering urban development around fast collective transport connecting high-density nodes of residences, places of employment, and commercial and leisure activities.

China can choose through public or private ventures the type of vehicle technology that is most sustainable and desirable. Developed countries went through many kinds of engines and fuel combinations in the early part of the 20th century without the benefit of computer diagnostics and other advanced technologies. The decision by GM to produce automobiles for unleaded fuel in their Shanghai factory in the late 1990s is an example of a leapfrogging choice. Given the rapid growth rate in passenger automobile ownership in China, a very large share of the vehicles on the road in 2010 will be built for unleaded fuel. By contrast, it took more than a decade in the US or Europe for cars built for leaded fuel to be replaced.

These opportunities to introduce new development policies and technologies arise because there are so few passenger automobiles in China. Moreover, Chinese decision-makers can look back on more than 100 years of evolution of transport, including vehicles, fuels, infrastructure, and even the form of cities, to see how others have minimized (or failed to minimize) unsustainable transport. Every year of inaction on the part of authorities, fuel suppliers, vehicle makers, or consumers means an enormous opportunity lost because of the significant growth in new vehicle sales, urbanization, population, and transport infrastructure construction.

A final encouraging facet of China's economic growth is its emergence as an important manufacturer and exporter of cars. Twenty years ago, other Asian countries began to follow Japan in manufacturing household appliances, which soon were built to meet tough Japanese and American efficiency standards. Rather than manufacturing one line of cars for China and one for export, Chinese car makers and authorities could aim at tougher fuel economy and emissions norms that would satisfy countries around the world, and not just the Chinese market.

Given all these conditions, China has choices other countries do not. This volume is about presenting these choices. The choices involved are mostly related to politics and policies that are not yet determined. China has not implemented fuel taxes or other strong economic instruments that give clear incentives to vehicle manufacturers, vehicle users, travelers or other actors in transportation. China has promulgated important fuel quality, vehicle emissions, and fuel economy standards, but these can be improved if they are combined with fiscal policies.

Motorization itself can promote economic growth, increase social welfare, and allow the freedom of access. However, the speed at which motor vehicle ownership and, more important, utilization, is rising is causing strains on people and on the transport system. The heavy focus on providing road and parking space to cars while essentially ignoring "the weak," such as travelers in non-motorized modes and collective transport, creates an imbalance in the transport system.

In addition to the provision of good collective transport systems, it is also important to have certain restraints on vehicle use. Successful examples from Singapore and, more recently, London and Stockholm have shown that pricing policies are effective in reducing congestion when used as transport demand management tools. While careful pricing alone does not insure efficient outcomes, pricing sets the stage by creating incentives for sustainable travel behavior and infrastructure investments.

China in 2020

Over the past few years *EMBARQ*, the World Resources Institute (WRI) Center for Sustainable Transport, with advice from many of its Chinese colleagues, has developed scenarios of passenger automobile ownership, use, fuel consumption, and carbon dioxide emissions for China. The scenarios were developed to show the consequences of choices - not make predictions. The details of the scenarios, including the results and assumptions, are given in Schipper and Ng (2004) and Ng and Schipper (2005). The results for fuels and CO_2 emissions are shown in Figure 16.

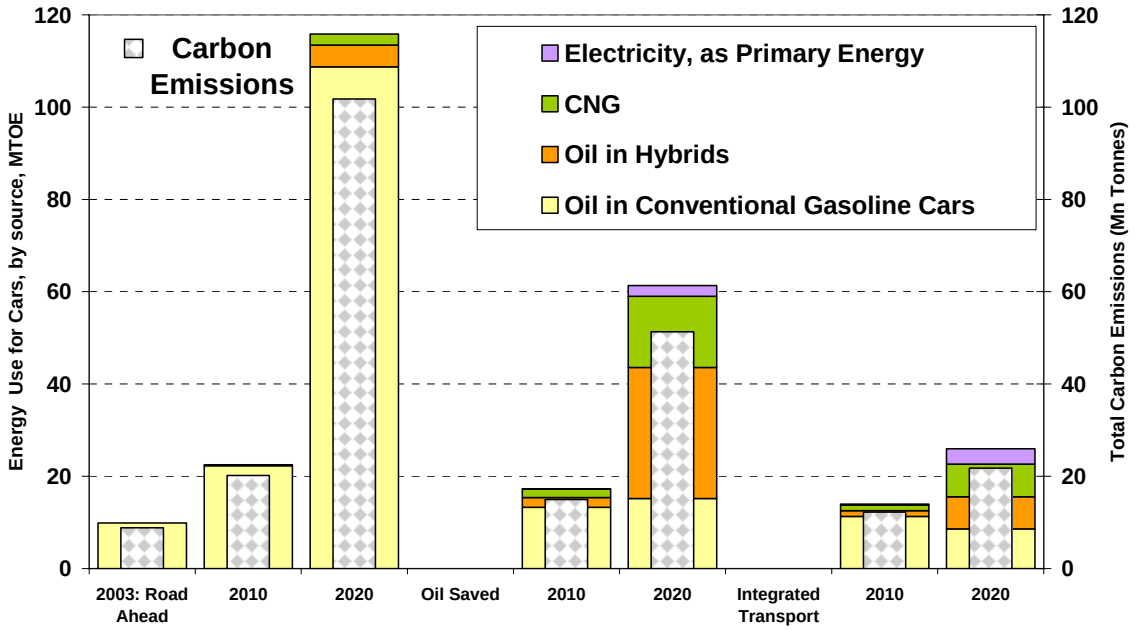

Figure 16. Energy use by fuels and carbon emissions from passenger automobiles in China in the three transport scenarios for 2010 and 2020.[3]

In the first of the three scenarios, "The Road Ahead," China in 2020 has the same GDP per capita as Korea did in 1995, and the same ratio of passenger automobiles to GDP that Korea had. This gives China approximately 145 million passenger automobiles, which is not far from many other extrapolations, both official and otherwise. By 2020 in this scenario, China's overall economy is large but the level of oil use for cars, approximately 2 million barrels per day, is still considered small relative to other uses of oil in the economy. At the time of writing (spring, 2007), we certainly know the concern over global oil supply is heightened in China and elsewhere. This makes "The Road Ahead" even more important for policy makers, because it shows where oil consumption for passenger cars in China is headed, given the current trends in car manufacturing and ownership.

In the "Oil Saved" scenario, China and the world see a continuation of the present high oil prices, with continual upward spikes. China implements policies to regulate the market and influence car ownership and use. The higher oil prices have only a small effect on car ownership, consistent with international experience. However, driving distance decreases from "The Road

[3] Note CO_2 emissions are 44/12 times that of carbon emissions.

Ahead" scenario, and fuel economy is approximately 25 percent better. In this scenario, fuel demand still grows by over 1 million barrels per day (bpd), but the growth rate is reduced considerably by both greater efficiency and lower driving brought on by a combination of higher fuel prices and strengthened efficiency standards. In *EMBARQ*'s study, we assume that there is modest progress in the use of CNG, some use of electric cars, and a modest penetration of efficient hybrid vehicles to illustrate the impacts of these changes. In short, policies focused on energy efficiency and alternative fuels can have a meaningful impact. These changes also bring CO_2 emissions down considerably from where they would be in "The Road Ahead" scenario. However, the size of China's fuel bill for passenger automobiles still remains large.

The third scenario, "Integrated Transport," presents an estimate of what would happen to passenger car ownership/use and fuel consumption in a future where concerns for sustainable urban transport system dominated policymaking. As a result of the growing problems of congestion and parking, the boom in car ownership weakens, and car utilization is considerably lower than in the other two scenarios. In short, physical space is a constraint and authorities are assumed to take strong measures to improve accessibility and to reduce both transport congestion and travel time. Given the high levels of congestion, passenger automobiles are small and very efficient, with a large number of small hybrid vehicles. Most Chinese car buyers are looking for quality and ease of use in congested cities, not weight, power, and size. With high speeds a rare occurrence and long driving distances uncommon, many vehicles could be small electrics with limited range and speed. When all these factors are combined, annual fuel use for cars winds up at just over twice what it was in 2003, still less than 25 percent of its value for 2020 in "The Road Ahead" scenario, and less than half of the fuel used is gasoline. At this level, much of what is proposed for alternative fuels becomes affordable.

Conclusion

There is no doubt that the role of private investments in economic development will continue to grow in China, and clear environmental standards and land use planning are important to help redirect transport towards a sustainable trend. Market signals are essential to move in that direction, and both private and public investments in transport systems are necessary as well. A key role of national or local regulations is to create market conditions where both public and private interests are aligned. What China lacks is the capacity to manage urban transport planning in a sustainable manner. Transport does not become sustainable solely after key laws are passed, investments are made, and technologies are deployed. Rather, sustainable transport must be monitored and managed constantly for better performance.

Future projects should focus on establishing good data collection and management tools that will quantify and evaluate mobility, especially in distance traveled on a city level for rapidly developing medium-sized cities. Such tools will illustrate present and future mobility patterns in China, according to current and projected travel demand. It is important to integrate transport needs with urban land use, and also to understand the direct impact of urban land development on transport demand, including vehicle range and fuel filling requirements. An exciting development we have not included in great detail in this study is that of electric two-wheeled bicycles or full mopeds, which have gained increased popularity over the past few years in cities such as Shijiazhuang, Beijing, Shanghai, and Kunming. Another crucial area for future projects is the role of transport pricing policies. Without the regulation of private vehicle use, congestion, emissions, and safety will still be a growing problem. Congestion pricing and innovative parking

systems, which regulate the use of private vehicles by increasing the total cost of driving, should be analyzed and implemented in selected Chinese cities to demonstrate their benefits.

The lessons from these scenarios underscores a key theme of this volume: While efficient vehicles and alternative fuels are necessary for restraining the rise in any country's energy use for personal automobiles, these elements alone are insufficient for holding back the rapid growth of oil demand in China. Instead, integrated urban transport solutions, which are also needed to keep China's cities livable and vibrant, will provide about as much restraint as fuel efficiency and fuel choice combined.

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